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Test Cart Requirements

for the

Generation-3
Personnel Safety System
(PSS)

of the

Advanced Photon Source

at

Argonne National Laboratory
9700 Cass Avenue
Argonne, Illinois 60439

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1. Introduction

1.1 System Purpose

This Test Cart Requirements contains the requirements for the design of the Personnel Safety System (PSS) Test Cart.

1.2 System Scope

This requirements document is limited in scope to the PSS test cart which will be used to validate all PSS Version 3 beamlines. For requirements specific to an individual beamline, refer to the User Software Requirements Specification.

1.3 Definitions, acronyms, and abbreviations

The following are some of the frequently appearing or unique acronyms used in this document. This list is provided as a quick reference for the reader's convenience.

ACIS	Access Control Interlock System
APS	Advanced Photon Source
ASD	Accelerator Systems Division
BLEPS	Beamline Equipment Protection System
CPU	Central Processing Unit
C&C	Command and Control
DIW	De-ionized Water
DOE	Department Of Energy
EPICS	Experimental Physics and Industrial Control System
EPS	Equipment Protection System
ES&H	Environment, Safety & Health Manual
ESD	Emergency Shut Down
FEEPS	Front End Equipment Protection System
FERDP	Front End Relay Distribution Panel
FOE	First Optics Enclosure
I/O	Input Output
IOC	Input Output Controller (data collection for EPICS)
LAN	Local Area Network
OI	Operator Interface
PSS	Personnel Safety System
PLC(s)	Programmable Logic Controller(es)
PMD	Programmable Message Display
SAD	Safety Assessment Document
SDD	Software Design Document
TBD	To Be Defined/Decided
VME	Versa Module Eurocard
XFD	Experimental Facilities Division

1.4 References

Government Documents
The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

Department of Energy (DOE) ORDER 420.2A, 01-08-01
Accelerator Safety Implementation Guide for DOE O 420.2A, Draft, August 2001
DOE ORDER 5480.25, 11-3-92
DOE GUIDANCE 5480.25, September 1, 1993

DOE ORDER and GUIDANCE 5480.25 are included because they were in effect and referenced when the Safety Assessment Document (SAD) was originally written; it has been superseded by DOE ORDER 420.2, which has been superseded by DOE ORDER 420.2A. DOE ORDER 420.2(A) essentially made the approved SAD the effective regulatory document.

Copies of specifications, standards, drawings and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting office.

Non-Government Documents
The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.
Environment Safety & Health Manual, Section 5.16 (ES&H 5.16) April 25, 2003, Argonne National Laboratory.
APS Safety Assessment Document (SAD), Rev 1, May 1999, Argonne National Laboratory, Argonne, IL.

Compliance with the following required by SAD:
Stanford Linear Accelerator Center Report 327 (SLAC 327), April 1988, Stanford Linear Accelerator Center, Menlo Park, CA.
National Council on Radiation Protection Report No. 88 (NCRP 88), Issued 30 December 1986, National Council on Radiation Protection.
Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

1.5 System Overview

The Validation Test Cart functions as a hardware tool to create simulated inputs and outputs for PSS Version 3 software validation at the Advanced Photon Source at Argonne National Laboratory. It will be configurable for the testing of any Version 3 system at the APS. The design of the test cart provides for non-invasive validation, as no PSS hardware will be disconnected or re-wired in any way to allow for validation of PSS elements. All input and output signals will be sent via profibus connection to separate modules residing on the test cart. This will eliminate errors introduced into the system through incorrect changes of connections both during and after validation is completed.

1.6 System Components

Three variations of validation test carts will be created. Each of the above mentioned Validation Test Carts will be comprised of Siemens Simatic S7-300 PLC I/O modules. Three modules (Two Output, One Input) will be used for Chain A, and an additional three modules will be used for Chain B. The modules will be connected via cabling to a 120 pin connector on a PC board located on the FERDP or in the Station cabinet enclosures. Each of the Test Carts will provide point to point I/O for each Input and Output contained in Chain A and Chain B logic. The modules will be communicating via Profibus connection to the corresponding PLC chain in the rack being tested.

2. PSS Definition, Policy, and Responsibility

The definition, policy, and responsibility sections listed below are provided as broad guidelines to establish the PSS requirements.

2.1 System Overview

The Personnel Safety System (PSS) is the access control and safety interlock system for the enclosures (stations) of the synchrotron radiation (X-ray) beamlines, of the Advanced Photon Source, at Argonne National Laboratory. Its function is to prevent personnel injury from synchrotron radiation hazards associated with the operation of a beamline. It also incorporates control functions for operation of the beamline.

2.2 Definition

The APS PSS is a high reliability, fail-safe, redundant, stand-alone system that carefully monitors and controls personnel access into potentially hazardous Experimental Stations and inhibits or reduces the hazard to mitigate harm to personnel. The only hazards in the experimental area of the APS which the system is designed to guard against are the direct X-ray radiation from the APS. These hazards are inhibited by controlling beam stops or by aborting the Storage Ring beam.

The system's responsibility is first and foremost safety, but significant attention is given to meeting user requirements and ergonomic issues relating to the system's use. The system is not intended to provide security.

2.3 Policy

The APS/ASD will design, install, commission, and maintain the PSS. The PSS is a sensitive system that has additional requirements due to its nature. Therefore, users are not allowed to perform any work on the PSS and not tamper with this equipment. Refer to APS Revision 1 Safety Assessment Document (May 1999) for further clarification. It is also the policy of the APS/ASD to test this system every 12 months.

Within the scope of the definition in section 2.2 above, and other mandates imposed by APS, DOE or other organizations with authority to regulate, the user requirements contained in this document are in compliance with an approved Beamline Final Design Report (FDR) as defined in section 2.2 above.

2.4 Responsibility

It shall be the responsibility of the user to provide sufficient information at reviews and subsequent PSS meetings to ascertain the adequacy of the beamline design with particular attention focused on showing that user designs do not adversely affect the operation of the PSS.

3. System Description for Typical PSS

The following is a brief description of the Personnel Safety System. Numerous other documents will be available such as operating manuals and search and secure procedures to provide additional in depth information.

3.1 Door Interlocks

All personnel access doors into an experimental station will be interlocked and monitored such that in the event any door is open, beam to that station will be inhibited. Door closed position is monitored by redundant, dissimilar switches.

3.2 Search and Secure

All experimental stations must be searched and secured to insure that personnel are not located within the enclosure during beam running periods. The search sequence is enforced by the PSS.

3.3 Global On-Line Mode

A Global On-line Mode will exist during normal running periods. The PSS may be brought off-line during down periods or extensive repair periods. This is accomplished by a special "key" that must be inserted into a special ACIS/PSS cabinet located in the control room above the storage ring. Users will not have access to this key.

3.4 User Control

The PSS will provide, on the experimental floor, a means to control critical safety devices and automatic station doors in the beamline. The Beamline PSS OI Terminals are the primary means to control safety related devices and are used during each access. Station door operation and open/closed status is provided by Door Controller Panels and Door Control Boxes. If different beam modes are required then a Mode Controller Panel is provided.

3.5 Operator Interface

The primary means for human interface with the PSS are the OI Terminals which consists of simple programmed control switches and LED indicators on the OI Terminals. Additional in-depth information regarding the PSS will be provided by EPICS screens run on workstations.

3.6 Faults

OI Terminals provide fault status(i.e. Minor, Serious or Major Faults) and a means to reset faults.

4. Experimental Station and Beamline APS Requirements

The experimental stations represent a major component of the PSS. The PSS interlocks station door operation, provides for emergency egress, enforces a logical search sequence of the area, provides audible and visual alarms and numerous other features to insure the safety of personnel. Toward this end, there are APS/ASD personnel safety requirements that must be met to insure that the effectiveness of the PSS is not affected by user equipment, systems, subsystems, etc.

4.1 Audible and Visual Warnings

Audible and visual alarms are installed in the experimental station to warn personnel of potentially dangerous events; typically that the area will be secured and that personnel within the enclosure must vacate. User equipment located inside the experimental station must not interfere with the effectiveness of these alarms.

4.2 Accessibility and Visibility

Every attempt has been made to install PSS equipment where it is easily visible and easy to operate. User equipment must not interfere with accessibility to PSS equipment. Inside non-monochromatic experimental stations the downstream wall within 1 meter of the beam path is considered an equipment free zone.

The number and location of PSS emergency beam abort buttons inside an experimental station depends on the size and geometry of each station in addition to accessibility inside the station. A two foot diameter equipment free zone around each PSS emergency beam abort button is required, wherever these buttons are located.

The number and location of PSS Search and Secure boxes at a given experimental station depends of the size and geometry of each station in addition to accessibility inside the station. There should be an equipment free zone (i.e. no other equipment within 2 feet) around each Search and Secure box. **The general criteria for the locating Search boxes is to force a uni-directional sweep of the area being secured, such that line of sight is provided to all spaces that could be occupied by a human. The search must end outside the station.**

4.3 Cable and Wireways

The PSS has its own dedicated cable tray and wireway. User cables must not use the PSS dedicated tray or wireway.

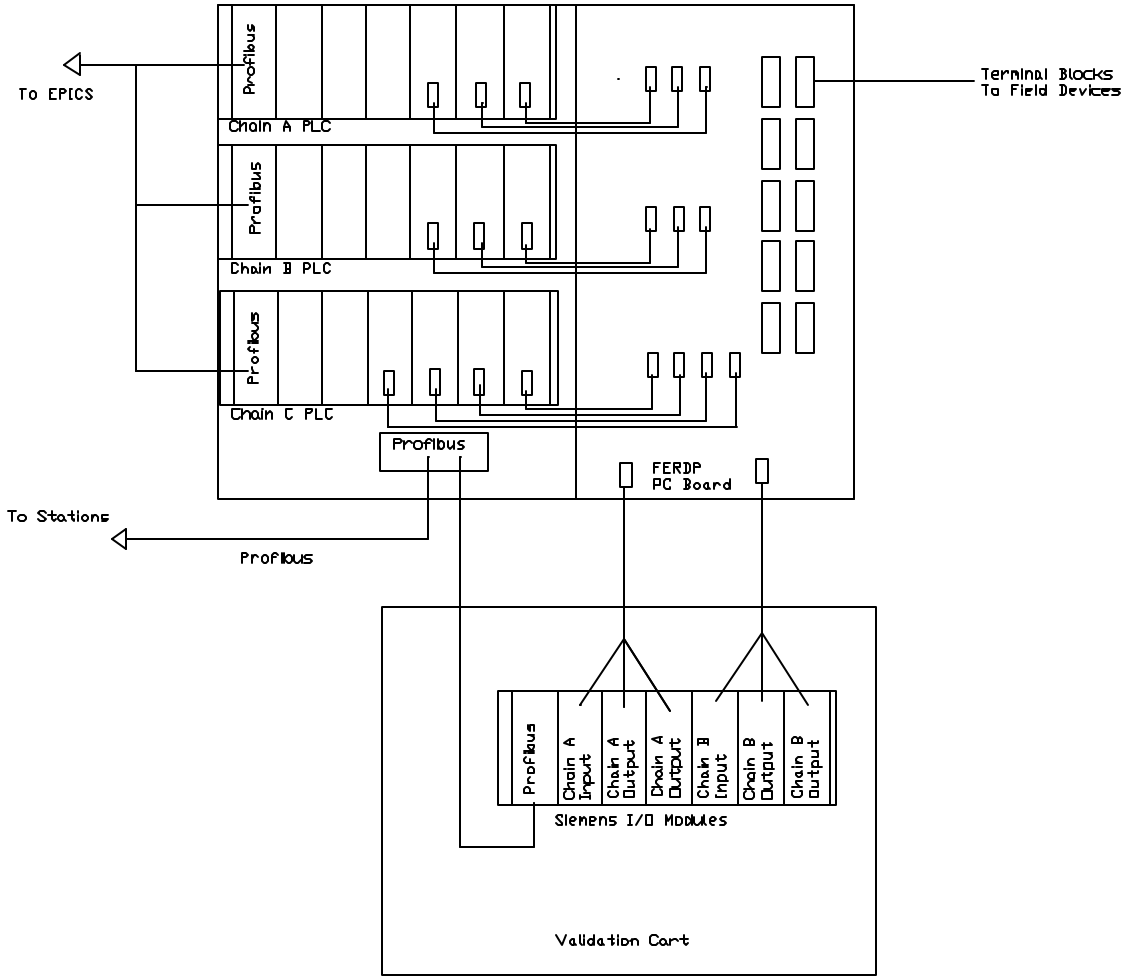
4.4 Radiation Critical Devices

Designers of the beamline must provide for the installation of devices that can inhibit a beamline during accesses. Since all aspects of the safety system are redundant, two such devices must be implemented. Note that these devices must be dedicated strictly for the PSS and may not be used for any non-safety purpose. All non-monochromatic critical device beam stops in ID beamlines must have redundant coolant signals that will be interlocked to the PSS only as per APS/ASD policy.

5. Test Cart Diagrams

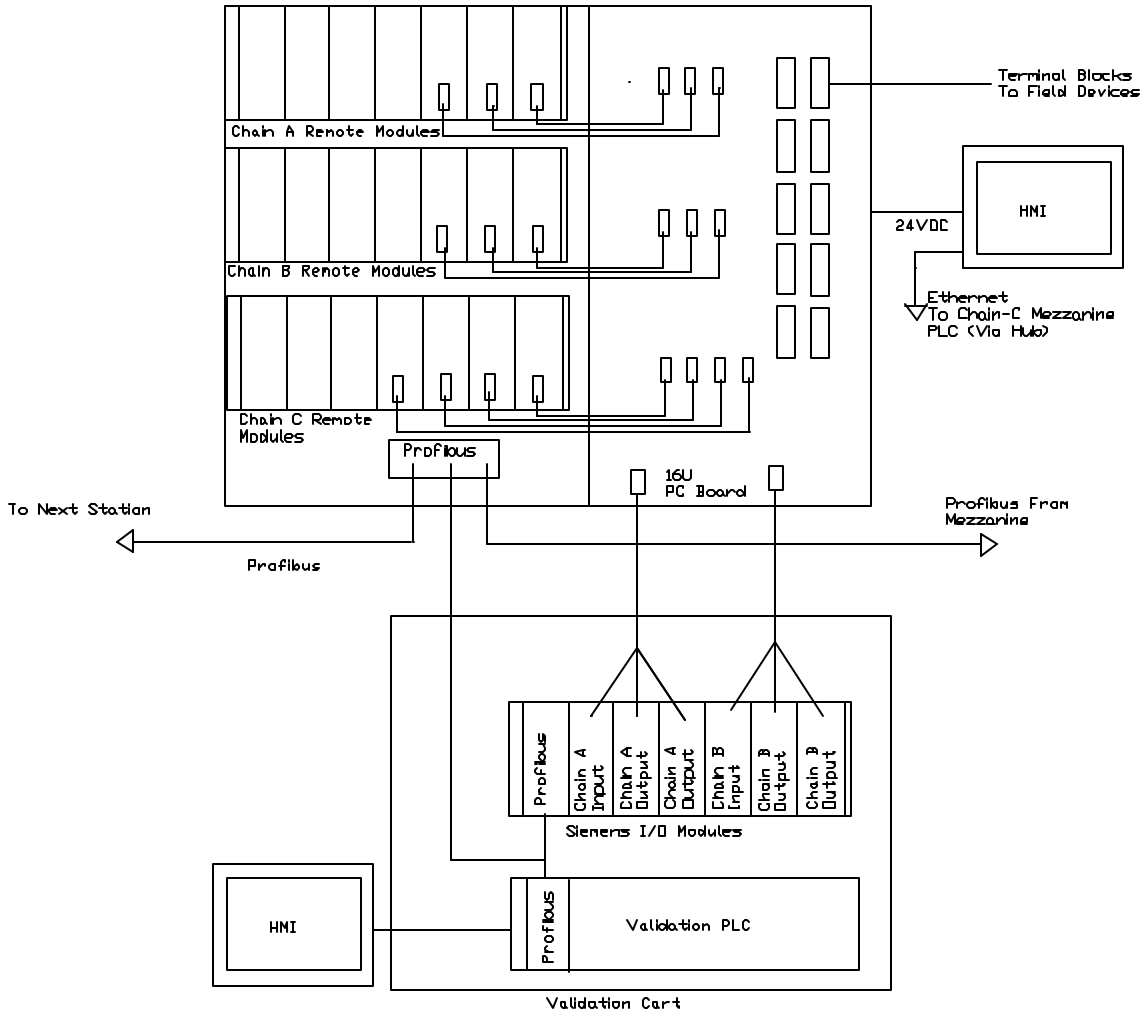
5.1 Test Cart One – Mezzanine

Cart One: This cart will reside on the mezzanine and connect to the FERDP.



5.2 Test Cart Two – FOE (Station A)

Cart Two: This cart will be designed for use in the FOE (Station A). This cart will additionally contain an HMI unit to simulate pushbutton inputs and LED outputs.



5.3 Test Cart Three – Experimental Stations

Cart Three: This cart will be connected to any additional experimental stations (B, C, D, etc)